

CLAIMS

What is claimed is:

1. A pressure-sensor system comprising:
 - a micro-electro-mechanical system (MEMS) pressure-sensing element to provide a pressure-sensing output proportional to a sensed pressure;
 - an amplifier to amplify the pressure-sensing output and provide an output voltage linearly proportional to the pressure; and
 - a voltage-to-frequency converter to receive the output voltage and to provide a digital-frequency output linearly proportional to the pressure.
2. The pressure-sensor system of claim 1 further comprising:
 - a temperature sensor; and
 - temperature-compensation circuitry responsive to the temperature sensor to provide a temperature-compensation signal at least to the amplifier, wherein the temperature-compensation circuitry is to at least partially offset temperature effects on the system.
3. The pressure-sensor system of claim 1 wherein the voltage-to-frequency converter is to provide:
 - a maximum frequency output when the pressure on the pressure-sensing element senses a maximum pressure; and
 - a minimum frequency output when the pressure on the pressure-sensing element senses a minimum pressure.
4. The pressure-sensor system of claim 3 further comprising offset-and-gain compensation circuitry to provide offset-and-gain compensation signals to the amplifier, wherein in response to the offset-and-gain compensation signals, the amplifier provides substantially a zero-voltage output at the minimum pressure, and the amplifier provides a predetermined maximum output voltage at the maximum pressure.
5. The pressure-sensor system of claim 1 wherein:
 - the pressure-sensing element is packaged within a semiconductor die, and
 - the sensed pressure is to deform the die.

6. The pressure-sensor system of claim 5 wherein the pressure-sensing element comprises a MEMS strain gauge.

7. The pressure-sensor system of claim 1 wherein the pressure-sensing element provides one of either a capacitive or resistive output in response to the sensed pressure.

8. The pressure-sensor system of claim 4 further comprising clock-generating circuitry to provide a clock signal to the voltage-to-frequency converter for use in generating the digital-frequency output.

9. The pressure-sensor system of claim 8 further comprising voltage-reference circuitry to provide a voltage reference to the voltage-to-frequency converter for further use in generating the digital-frequency output.

10. The pressure-sensor system of claim 9 further comprising power-supply circuitry to provide power to at least one of the amplifier, the pressure-sensing element, the voltage-to-frequency converter, the clock-generating circuitry, the voltage-reference circuitry, the temperature sensor, the temperature-compensation circuitry, and the offset-and-gain compensation circuitry.

11. The pressure-sensor system of claim 9 wherein amplifier, the voltage-to-frequency converter, the clock-generating circuitry, the voltage-reference circuitry, the temperature-compensation circuitry, and the offset-and-gain compensation circuitry is fabricated on a single semiconductor die.

12. The pressure-sensor system of claim 11 wherein the pressure-sensing element is also fabricated on the single semiconductor die.

13. The pressure-sensor system of claim 11 further comprising an on-die microcontroller to provide a digital-serial output based on the digital-frequency output and the clock signal.

14. The pressure-sensor system of claim 13 wherein the digital-serial output comprises a digital word indicating the sensed pressure.

15. A pressure-sensor system comprising:
a micro-electro-mechanical system (MEMS) pressure-sensing element to provide a pressure-sensing output proportional to a sensed pressure;
a voltage-to-frequency converter to provide a digital-frequency output linearly proportional to the pressure based on the pressure-sensing output; and
a microcontroller system, wherein the microcontroller system is to receive the digital-frequency output, is to determine the sensed pressure and is to generate a response signal for other system elements when the sensed pressure is either inside or outside a predetermined pressure range.

16. The pressure sensor system of claim 15 wherein the other system elements are responsive to the response signal.

17. The pressure sensor system of claim 15 wherein the microcontroller system and pressure-sensor system are located on a single printed circuit board.

18. The pressure sensor system of claim 15 wherein the microcontroller system and pressure-sensor system are fabricated on a single monolithic semiconductor die.

19. A pressure-sensor system comprising:
a package;
a micro-electro-mechanical system (MEMS) pressure-sensing element to provide a pressure-sensing output proportional to a sensed pressure;
a voltage-to-frequency converter to provide a digital-frequency output linearly proportional to the pressure based on the pressure-sensing output; and
a semiconductor die mounted within the package, the semiconductor die including the pressure-sensing element; and
a lid on the package having an opening to allow a fluid into the package, wherein the sensed pressure is to deform the die, and

wherein the pressure-sensing element is to provide either a capacitive or a resistive output in response to the deformation of the die.

20. The pressure-sensor system of claim 19 further comprising a silicone gel coating within a cavity of the package, the gel coating at least covering the die.

21. The pressure-sensor system of claim 20 wherein the package comprises lead-frames to couple with to circuit board.

22. The pressure-sensor system of claim 19 wherein the package is a surface-mount package comprising either a ceramic or laminate for attachment to a circuit board, the package comprising a dam surrounding the die and attached to the either ceramic or laminate.

23. The pressure-sensor system of claim 22 further comprising a silicone gel coating held by the dam, the gel coating at least covering the die.

24. The pressure-sensor system of claim 19 further comprising an o-ring seal around an opening in the lid to help prevent a liquid from escaping from the package, the pressure-sensor system to measure the pressure of the liquid.

25. The pressure-sensor system of claim 19 wherein the pressure-sensing element is fabricated with a first semiconductor die, and the amplifier and the voltage-to-frequency converter are fabricated as part of a second semiconductor die, the first and second die being coupled together and located within the package.

26. The pressure-sensor system of claim 19 wherein at least the pressure-sensing element, the amplifier and the voltage-to-frequency converter are fabricated as part of a single semiconductor die located within the package.

27. The pressure-sensor system of claim 19 wherein the temperature-compensation circuitry is to further offset the temperature effects on the pressure-sensing element and the voltage-to-frequency converter.

28. The pressure-sensor system of claim 19 wherein the temperature-compensation circuitry provide the temperature-compensation signal to help maintain a correspondence between a sensed pressure and the digital-frequency output for various temperatures.

29. A method of generating a digital-frequency output proportional to a sensed pressure comprising:

providing a pressure-sensing output proportional to a sensed pressure;

amplifying the pressure-sensing output to provide an output voltage linearly proportional to the pressure; and

generating a digital-frequency output linearly proportional to the pressure based on the output voltage.

30. The method of claim 29 wherein the sensed pressure is to deform a die comprising a pressure-sensing element and wherein the pressure-sensing output one of either a capacitive or resistive output, and wherein the method further comprises:

generating a temperature-compensation signal to at least in part offset temperature effects.

31. The method of claim 30 wherein generating the digital-frequency output comprises generating a maximum frequency output when the pressure sensed is a maximum pressure, and generating a minimum frequency output when the sensed pressure is a minimum pressure.

32. The method of claim 31 further comprising generating offset-and-gain compensation signals, wherein in response to the offset-and-gain compensation signals the method comprises providing substantially a zero-voltage output at the minimum pressure, and providing a predetermined maximum output voltage at the maximum pressure.

33. The method of claim 32 further comprising:

determining when the sensed pressure is either inside or outside a predetermined pressure range based on the digital-frequency output; and

generating a notification signal when the sensed pressure is either inside or outside the predetermined pressure range.

34. The method of claim 33 further comprising wirelessly transmitting the notification signal to another system element.

35. A product pressure-monitoring system comprising:
a pressure-sensing system comprising a pressure-sensing element to provide a pressure-sensing output proportional to a sensed pressure; and a voltage-to-frequency converter provide a digital-frequency output linearly proportional to the sensed pressure; and
a microcontroller system comprising a microcontroller and an RF transmitter, the microcontroller to receive the digital-frequency output, wherein the microcontroller generates a notification signal when the sensed pressure is either inside or outside a predetermined pressure range, and the RF transmitter is to transmit an RF signal in response to the notification signal, the RF signal indicating that the sensed pressure is either inside or outside the predetermined pressure range.

36. The system of claim 35 wherein the microcontroller system and pressure-sensor system are located on a single circuit board.

37. The system of claim 35 wherein the microcontroller system and pressure-sensor system are fabricated on a single monolithic semiconductor die.

38. The system of claim 36 further comprising an RF antenna to transmit the RF signal.

39. The system of claim 38 wherein the pressure-sensing system further comprises:
an amplifier to amplify the pressure-sensing output and provide an output voltage linearly proportional to the voltage-to-frequency converter;
a temperature sensor; and
temperature-compensation circuitry responsive to the temperature sensor to provide a temperature-compensation signal to the amplifier, wherein the temperature-compensation circuitry is to at least in part offset temperature effects on the system.

40. The system of claim 38, wherein the pressure-sensor system further comprises:
a package; and
a semiconductor die mounted within the package, the semiconductor die including the pressure-sensing element.

41. The system of claim 40 further comprising a lid on the package allowing either a gas or a fluid into the package, wherein the sensed pressure is to deform the die, and the pressure-sensing element is to provide one of either a capacitive or resistive output in response to the deformation of the die; and a silicone gel coating within a cavity of the package, the gel coating at least covering the die.

42. The system of claim 40 wherein the system is a tire pressure-monitoring system, and wherein pressure-sensing system and microcontroller system are to receive power from a battery.